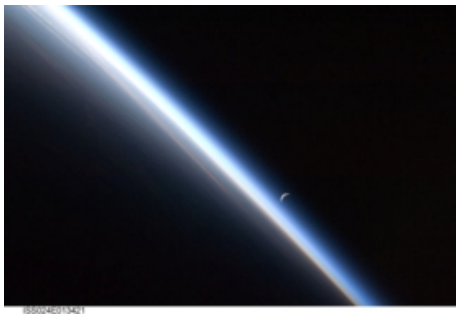
Could Diamond Dust Sprayed into the Sky Cool Earth?

Solid particles of diamond or alumina might be safer than sulphate droplets as a way to redirect the sun's energy, calculations suggest

nature

By Andy Extance and Nature magazine | October 27, 2015

Climate scientists have thought up plenty of futuristic ways to cool the planet, but an analysis published on October 26 examines what may be their wildest idea yet: spraying tiny diamonds high into the atmosphere.



A setting last quarter crescent moon and the thin line of Earth's atmosphere are photographed by an Expedition 24 crew member as the International Space Station passes over central Asia.

NASA

Researchers have for years discussed the merits of pumping water-based sulphate spray into the sky to reflect and scatter the Sun's energy—essentially, mimicking the cooling caused by volcanic eruptions. Like most kinds of geoengineering, the idea is highly controversial and so far untested.

But if anyone does try this 'solar-radiation management', then it may be safer to use dusts of solid, nanometre-sized particles, suggests a team of scientists from Harvard University in Cambridge, Massachusetts. In a paper published in *Atmospheric Chemistry and Physics*, they calculate that nanoparticles of diamond or alumina (aluminium oxide) could be more effective and less environmentally damaging than sulphates. And although diamond dust is expensive, it is not completely out of the question, the researchers argue.

"Our paper is really geared towards removing the mindset that it has to be sulphate that's used to do solar radiation management," says Debra Weisenstein, an

atmospheric modelling expert at Harvard and one of the study's authors.

Sulphate's side-effects

Other researchers have proposed spraying solid dusts before. But the latest study is the first to model the particles' effects in detail, Weisenstein says, by examining how they interact—both physically and chemically—with different substances in the atmosphere, and making the comparison with sulphates.

In the atmosphere, sulphates lead to the production of sulphuric acid, which damages the ozone layer. By absorbing certain wavelengths of light, they also heat up the lower stratosphere; that in turn could affect air-circulation patterns and climate. Sulphates would also diffuse light, an effect that could boost plant growth but would lower the power output of solar panels.

Alumina and diamond dust both lead to fewer problems, says Weisenstein. "You could have significantly less impact on ozone, less heating of the stratosphere and less of an increase in diffuse light at Earth's surface," she says. That is because alumina and diamond do not result in the production of sulphuric acid, and they scatter and absorb particular wavelengths of light in a different way.

Besides analysing environmental effects, the paper also shows that, pound for pound, alumina dust would achieve a similar cooling effect to that of sulphate sprays—but that diamond dust would be at least 50% more effective.

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Diamonds in the sky

Of course, spraying diamond dust into the sky would ring up a hefty bill. Diamond dust is less expensive than cut gemstones: tiny synthetic diamond particles are now available at less than US$100 per kilogram, the Harvard researchers note. But based on their paper's results, offsetting just a few percent of the energy trapped by human-emitted greenhouse gases would take hundreds of thousands of tonnes of dust annually. Although the Harvard researchers stress that they didn't do a detailed cost analysis, at current prices that would still require billions of dollars each year.

However, Weisenstein is adamant that the ultimate cost would be lower. "Once this can be scaled up to make the right quantities, you assume the price is going to drop," she says. "Trying to estimate based on how much diamond costs currently is not particularly useful."

And David Keith, a climate scientist also at Harvard and another of the paper's authors, says he does not think even today's costs would be prohibitive. By 2065, he says, with 10 billion people on the planet, the cost might be on the order of $5 per person to pump up some 450,000 tons of diamond dust.

Still, the Harvard team is focusing on alumina right now, Weisenstein says, because it's easier to make and its chemical behaviour has been better studied.

The scientists warn, however, that both alumina and diamond nanoparticles carry unknown risks. Sulphates are reasonably well understood, thanks to research on volcanoes. By contrast, the chemistry of the solid particles—such as how their surfaces catalyse chemical reactions—is not as clear, although the Harvard researchers are doing lab tests to remedy that.

The study "strongly suggests" that such solid dusts could significantly lower some of the risks associated with sulphates, says Matthew Watson, a volcanologist at the University of Bristol, UK, who was the principal investigator on one cancelled small-scale geoengineering experiment, the Stratospheric Particle Injection for Climate Engineering project, or SPICE. But he suspects that the unknown risks and lack of any natural analogue will make solid dusts even less popular with the public than are sulphate sprays.

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Comments

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llirbo October 27, 2015, 6:19 PM

What an absolutely asinine, short sighted, Dr. Strangelove-like idea!!!!!

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ErnieG October 27, 2015, 8:19 PM

Who is going to pay for this and similar efforts? Will it be the polluters or tax payers trying to support further pollution.

For that matter who will pay for unexpected side effects of this "solar screen" like for lost crops due to drought or flooding? International law suits could be interesting.

Are the polluters paying for the research?

Lets just reduce carbon emission. I am working on reducing my households pollution including CO_2. Some people may have to be taxed before they pay attention and this may require a pollution tax on goods from China, I bet they could clean up there act faster than here in the USA.

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Darcival ➦ **llirbo** October 27, 2015, 9:21 PM

Lair I.

Agreed. Human hubris beyond the limits.

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mjfoysr1 October 27, 2015, 9:27 PM

what about the precipitation effect? Over time we would likely experience fallout from these sharp edged or round particulates. What would the impact be on air quality? Especially for ill, elderly and young humans and animals? Would there be an impact on aircraft engines or surfaces?

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fbahadir October 27, 2015, 9:31 PM

Who will pay back the cost if does not work?

Who will pay for the damage if it causes a disaster?

Even it works perfectly (I would say one in billion chance), whenever a hurricane, drought, flood causes damage people who done it would get the blame and asked for the damages.

I say these for all geoengineering ideas, not just this one!

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Steven October 28, 2015, 12:03 AM

Zecharia Sitchin wrote a series of books he referred to as the Earth Chronicles. Although he passed away a number of years ago, he translated a lot of Summerian tablets from antiquity from which he derived his theories.

He referred to a civilization from another planet, planet X or Nibiru, which had a deteriorating atmosphere, and the "Annunaki" were coming from there to earth in search of gold to replenish the atmosphere of their planet which had a deteriorating atmosphere, apparently due to environmental devastation.

Apparently they were putting gold nanoparticles into their atmosphere to try to restore it.

Although Archeologists and scientists don't often agree with his theories, the ideas of putting something into the deteriorating atmosphere to restore it seems to have gained respectability from the modern scientific community and seems to give his ideas or theories some credibility.

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danilko1 October 28, 2015, 1:36 AM

This is just as wild as any other plan, but I had the idea of using a conveyor system to toss aggregate off the Moon in the same orbit, around Earth. All the aggregate would fall back to the Moon over time. The only effect would be, to reduce the amount of sun light that hits the Earth.

This would also form a disc, much like Saturn.

The plan is that this material would not enter Earth's atmosphere and should not interfere satellites, as all the action would happen about 380,000 km out.

The moon dust could be tossed out from the far side, by robotic conveyor. Material could be mined on site, crushed and sent into orbit. There is no atmosphere to get in the way, and the amount of energy/force needed to get it into orbit is much less than on Earth. The amount of material used can be adjusted as needed.

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danilko1 ➦ **ErnieG** October 28, 2015, 1:44 AM

Who pays? We all pay. There certainly are gross polluters, much like the 1% vs 99% in the economy, we also have a handful of polluters doing a great amount of damage. But the problem isn't simply caused by them, it's caused by all of us, cars, by biology, peat bogs, cows, ants, and so-on.

The solution will take all of us to participate. WE all have to invest in our future to experience value in that future.

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sofistek October 28, 2015, 2:37 AM

Surely, there wouldn't be enough diamond dust available each year to do this. As far as I can tell, there are about 26 tonnes of diamond mined every year and about 1000 tonnes of synthesised diamonds made every year. Even if you ground all of these into dust, it would only be a tiny fraction of what is needed.

Why do scientists and technologists never looks at resource limits?

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